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Food, medicinal plants, and homemade beverages, used as a response to the pandemic in Ethiopia

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Abstract. *Megersa M, Dida G, Gadissa F, Sebsibe A, Germame A, Alemayehu G, Kebede B, Bekele D, Belachew S. 2022. Food, medicinal plants, and homemade beverages, used as a response to the pandemic in Ethiopia. Biodiversitas 23: 2146-2155.* SARS-CoV-2, which is responsible for an infectious disease called COVID-19, significantly impacted the global community, including Ethiopia. Meanwhile, people responded to the disease in various ways using available household materials. These include food, medicinal plants, and household beverages used for preventing and curing symptoms of COVID-19. Thus, the present study was initiated to assess these foods, medicinal plants, and beverages used in Ethiopia during the COVID-19 pandemic. This study used a web-based survey and phone call to collect data related to food, medicinal plants, and beverages used during COVID-19 by emphasizing medicinal plants. The questionnaire was created through Google Form and circulated through social media such as Facebook, Telegram, and Whatsapp. A total of 680 respondents took part in the survey. Relative citation frequencies (RFC) were calculated to assess popular medicinal plants used to prevent or mitigate the disease. A total of 53 medicinal plants used to prevent and cure COVID-19 distributed to 24 families were recorded. Leaves (30%) were the most frequently utilized plant part. The respondents indicated that they were using medicinal plants for COVID-19 prevention at least once a day, accounting for (41.3%). Most of them recommended using medicinal plants to prevent the disease. Relative frequency of citation (RFC) indicated that *Zingiber officinale* Roscoe was the most popular medicinal plant used during the pandemic. Apart from medicinal plants, foods and beverages were also frequently used during the pandemic. The majority of respondents (49.6%) mentioned that local communities were their source of information. Respondents also indicated the use of the medicinal plant has increased during the first three months of the COVID-19 pandemic claiming that they have the potential to prevent and cure COVID-19. However, this should not be considered a panacea since the effectiveness of these medicinal plants, foods, and beverages has not been confirmed.

Keywords: COVID-19, food, lockdown, medicinal plants, pandemic

Abbreviations: COVID-19: Corona Virus Disease 2019; COVAX: The COVID-19 Vaccine Global Access; RFC: Relative Frequency; FC: Frequency of Citation; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; WHO: World Health Organization

INTRODUCTION

SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), responsible for an infectious disease called COVID-19, significantly impacted the global community. The virus was first reported in Wuhan, Hubei Province, China, in late December 2019 (Chinese Center for Disease Control and Prevention 2020). As a result, the World Health Organization declared the disease a pandemic and public health emergency of international concern posing a high risk to countries with vulnerable health systems on January 30, 2020 (WHO 2020). Since the disease was declared a pandemic, several research groups have risen to the challenge and developed SARS-CoV-2 vaccines, which protect against the virus that causes COVID-19 (Roser et al. 2022). As a result, about 115 vaccines against SARS-CoV-2 have been developed and in clinical trials on humans (Zimmer et al. 2022). Some vaccines reportedly have more than 90% efficacy against COVID-19 in clinical trials (Knoll and Wonodi 2021). At present, 12 vaccines are used for COVID-19 prevention and are authorized by at least one national regulatory authority (Zimmer et al. 2022).

Now the challenge is to make these vaccines available to people around the world. It will be key that people in all countries, not just rich countries, receive the required protection (Roser et al. 2022). But currently, showed a huge discrepancy in Northern and Southern nations, where many doses are administered to the northern nation where only 12% of the people in low-income countries have received at least one dose (Roser et al. 2022). Southern nations could not afford the vaccine's cost and are getting the vaccine through the COVAX. Oxford-AstraZeneca's US$2-3 per dose agreement with the COVAX Facility holds good promise for equitable access for Low Middle-Income Countries, compared with the high cost of the two

(Pfizer and Moderna) vaccines that have reported more than 90% efficacy (McCarthy 2020; Zimmer et al. 2022).

Due to the limitation of medical personnel and provisions and the high cost of fundamental medicine, developing countries desire traditional medicine (Chaachouay et al. 2021). This scenario also works for access to COVID-19 vaccines by developing nations. Hence, there is no other way apart from protecting themselves from the disease by easily available materials such as the utilization of homemade beverages, foods, and medicinal, among others.

Communities mainly living in developing countries depend on plants for different purposes such as food, medicine, and houses (Balick and Cox 1996; Cunningham 2001). Plant species play a vital role in advancing modern studies by serving as a starting point for drug discovery (Wright 2005). Various modern drugs were extracted from traditional medicinal plants using plant material following the ethnobotanical leads from indigenous cures used by traditional medical systems (Verma and Singh 2008).

People have used medicinal plants to fight against pandemics in the past decades (Arora et al. 2011; Luo et al. 2020), and the outbreak has increased the demand for medicinal plants these days around the world as medicinal plants can be an alternative option to prevent COVID-19 (Luo et al. 2020; Khadka et al. 2021). A study conducted in several countries showed increased consumption of ginger, garlic, onion, turmeric, and lemon as immune boosters during the pandemic (Pieroni et al. 2020; Vandebroek et al. 2020; Ammar et al. 2021). In addition, a study conducted by Khadka et al. (2021) recorded 60 plant species used to prevent COVID-19 by communities of Nepal. In a similar study, Chaachouay et al. (2021) reported that 20 plant species were used by communities living in North-Western Morocco.

Apart from medicinal plants, homemade beverages (alcoholic and non-alcoholic), honey bee products, fungi (*Ganoderma* spp. and *Inonotus obliquus*), algae (Spirulina, *Arthrospira platensis*) (Pieroni et al. 2020), and zinc/vitamin supplements (Celik et al. 2021; Khabour and Hassanein 2021) have been used by people living in several countries to prevent COVID-19.

The first COVID-19 case was confirmed by The Federal Ministry of Health in Ethiopia on March 13, 2020, after a Japanese national arrived in Addis Ababa from his Burkina Faso trip, tested positive for the novel COVID-19. From this time onwards, there was an increasing case daily along with a fragile health care system and lack of infrastructure. Hence, home-based remedies such as foods, medicinal plants, and beverages are used by Ethiopians as an alternative option to prevent COVID-19. Thus, the present study is initiated to assess these foods, medicinal plants, and beverages used in Ethiopia during the COVID-19 pandemic. The implied hypothesis is that Ethiopian populations utilized one or more plants and beverages during the COVID-19 pandemic.

MATERIALS AND METHODS

Study area

Ethiopia is Africa's second most populated country and one of the world's least developed countries. According to Worldometer, Ethiopia's current population is projected to be 118 million people, with most of the population living in rural regions. The Ethiopian government has committed to increasing access to critical healthcare services for all residents through decentralization, fostering private-sector partnerships, and involving all stakeholders (Woldemichael et al. 2019). Information was gathered from respondents all over the country except in the Tigray region due to the conflict in the region. The majority of respondents reside in the Oromia region, followed by Amhara. The distribution of cases by region was as follows: Addis Ababa city (58,457 cases representing 53% of all cases), Oromia (18,509 cases), Amhara (6,383 cases), Southern Nations Nationalities and Peoples-SNNP (4,084 cases), Sidama (3,412 cases), Dire Dawa city (2,863 cases), Harari (2,727 cases), Benisghangul-Gumuz (2,496 cases), Afar (1,810), Somali (1,670 cases) and Gambella (1,001 cases) (UNICEF 2020).

Data collection

This cross-sectional study was performed through a web-based survey to collect primary data on food, medicinal plants, and beverages used during COVID-19 by Ethiopian communities. The questionnaire was created through Google Form and circulated through social media such as Facebook, Telegram, and Whatsapp. The survey link was also administered through email, and it was open for a month from March 31 to May 08, 2021. In 38 days of duration, 680 respondents took part in the survey. Friends on Facebook and telegram played a vital role in reaching this number. We tracked the completion of questionnaires during the online time, observing the date and time the survey ended. In addition, a questionnaire was distributed, and a phone call was made to collect data from respondents. The questionnaire was mostly circulated to the literate Ethiopian populations who have access to the internet. Respondents were included in the survey if they live in Ethiopia with high school graduates at the minimum criteria. Respondents permanently living outside of Ethiopia were not invited to complete the survey. We asked the respondents about the name of local plants, their uses, mode of preparation, plant parts used, dosages, and price of plant species considered to prevent COVID-19.

Local names of the plant species were the base for identification. Botanical identification of plants was made using various volumes of the flora of Ethiopia and Eretria and Honey Bee flora (Hedberg and Edwards 1989; Edwards et al. 1995; 1997; 2000; Fitchl and Admasu 1994; 1995; Hedberg et al. 2006a,b; Bekele-Tesemma 2007). In the floras, local names, the regions where the plant grows, and its uses were considered to develop appropriate scientific names. We authenticated the scientific names, families, and authorities using available online sources (https://www.ipni.org/ and http://www.theplantlist.org).

A consent letter was obtained from Madda Walabu University before the online survey. A consent message was written to all the people on the online survey, written at the top of the form. Participants were informed to fill out the online questionnaire on a pure volunteer basis with a full right not to answer all or any of the questions. Participants were informed as the online survey has no personal identifier and moreover. They have also informed us there is no harm or risk to them by participating in the online survey.

Data analysis

Descriptive statistical tools such as percentage and frequency were used to analyze and summarize data on food, medicinal plants, beverages and their uses, and other related information using MS Excel 2010. Moreover, these data were analyzed using the frequency of citation (FC), and the relative frequency (RFC) value was calculated following Tardío and Pardo-de-Santayana (2008):

$$RFC = FC/N$$

Where *FC*=Number of respondents who indicated they use the plant for COVID-19 prevention or treatment and *N*= Total number of respondents.

RESULTS AND DISCUSSION

Demographic profile of respondents

Of 680 participants who took part in the survey, 474 (69.7%) were male respondents, and 206 (30.3%) were female respondents. The age of the respondents varied from 20 to 61 years. Among them, 46% were found between 31 to 40 years of age; 26% were between the age of 20 to 30; 19.8% of respondents were found between the age of 41 to 50. Respondents aged above 51 years accounted for 8.2%. All of the respondents were literate, and most of them (80.5%) attended University, and 46% of respondents were lecturers.

Medicinal plants recorded

A total of 53 medicinal plant species were identified, which were distributed among 24 families. The most common families were Poaceae and Solanaceae (5 species each); Asteraceae, Brassicaceae, Lamiaceae, and Rutaceae, each represented by 4 species Apiaceae represented by 3 species (Table 1).

Medicinal plants use status for COVID-19

Out of 680 respondents, 580 (85.4%) respondents agreed that the use of the medicinal plant has increased during COVID-19; 56 (8%) agreed the use of medicinal plants during COVID-19 is the same as that of normal conditions, whereas 44 (6.5%) of respondents agreed that medicinal plants use during the pandemic decreased. When comparing the use of medical plants during the first three months after COVID-19 was recorded in Ethiopia with the current situation, 58.7% of respondents said the use of medicinal plants has declined, while 28.6% said the use of medicinal plants has grown.

Medicinal plant parts and conditions used to prevent COVID-19

According to the finding from the survey, leaves (30%) were the dominant plant part used for the preparation of traditional medicine. The other plant parts used were seeds (26%) and fruits (23%) (Figure 1). Respondents also indicated that medicinal plants mainly harvested were fresh (51%), followed by preparation either from dry or fresh plant parts (46%) and (3%) prepared from dried plant parts.

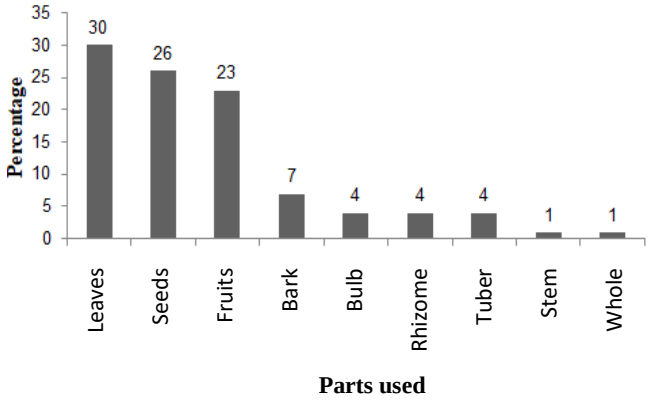

Figure 1. Plant parts used for medicinal purposes to prevent COVID-19

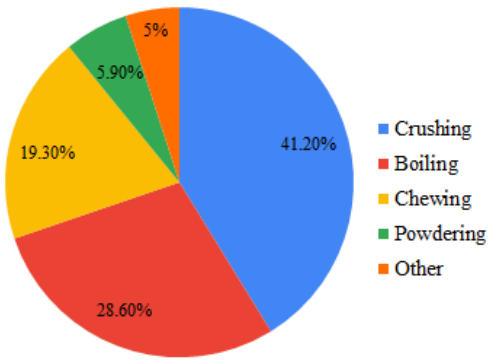

Figure 2. Method of medicinal plants preparation for COVID-19 prevention

Table 1. Medicinal plants are recorded with scientific name, local name, parts used, preparation method, and citation frequency. Local name (Am: Amharic; AO: Afaan Oromoo; Sh: Shekicho; So: Somali)

Family	Scientific name	Local name	Parts used	Preparation method	Number of citation
Acanthaceae	*Justicia schimperiana* (Hochst. ex Nees) T. Anders.	Sansal (Am), Dhummugaa (AO)	Leaves	-	7
Amaryllidaceae	*Allium sativum* L.	Qullubbii adii (AO)	Bulb	The crushed bulb is mixed with ginger and taken as a tea or eaten raw; boiled with milk	366
	Allium cepa L.	Shnkurt (Am)	Bulb	Eaten in a salad, added to various foods; Dried leaves also boiled and drink	47
Amaranthaceae	*Spinacia oleracea* L.	-	Leaves	Eaten raw	7
Anacardiaceae	*Mangifera indica* L.	Mango (AM, AO)	Fruit	Eat or drink the juice	14
	Schinus molle L.	Qundobarbare	Seeds	Chew the seeds	48
Apiaceae	*Foeniculum vulgare* Mill.	Arakee (Am)	Leaves	-	7
	Coriandrum sativum L.	Dimbilal (Am)	Leaves	-	7
	Cuminum cyminum L.	Kamun (Am)	Seeds	-	7
Asteraceae	*Artemisia abyssinica* L.	Qoddoo (AO), Chikugn (Am)	Leaves	Taken as tea	7
	Lactuca sativa L.	Selaxa (AO, Am)	Leaves	Eaten raw as a salad	7
	Echinops sp.	Kebericho	Bark	Inhale the smoke	52
	Guizotia abyssinica (L.f.) Cass.	Nuugii (AO)	Seeds	Boiled and drink	14
Brassicaceae	*Brassica oleracea* L.	Xiqil Gomman (Am) Raafuu maramaa (AO)	Leaves	Eaten cooked or as a salad	7
	Brassica carinata A. Br.	Gomman (Am) Goommana (AO)	Seeds	Dried seeds powdered and boiled in water	7
	Brassica nigra L.	Senafich (Am)	Seeds	Powdered and mixed with water	65
	Lepidium sativum L.	Shinfaa (AO) Fexo (Am)	Seeds	Eaten raw or cooked, mixed with the decoction of 'Kurunfud' and *A. sativum*	268
Bromeliaceae	*Ananas comosus* (L.) Merr.	Ananasii (AO)	Fruit	Eat fruit or boil and drink as tea	7
Celastraceae	*Catha edulis* (Vahl) Forssk ex Endl.	Jinaa (AO) Caat (Am)	Leaves	Boil with leaves of *E. globulus* and inhale the steam	39
Cucurbitaceae	*Coccinia abyssinica* (Lam.) Cogn	Ancootee (AO)	Tuber	-	13
Fabaceae	*Arachis hypogaea* L.	Ocholoni (AO, Am)	Seeds	Boil and drink as tea	13
	Trigonella foenum-graecum L.	Abasuuda (AO)	Seeds	Soak in water and drink the next day	39
Lamiaceae	*Ocimum basilicum* L.	Besobila (Am)	Leaves	Fresh leaves added to local food called 'wat'	13
	Ocimum sp.	Damaakse (AO, Am), Eyafa (Sh)	Leaves	Crush the leaves and rub on the face	52
	Rosmarinus officinalis L.	Siga metbesh (Am)	Whole	Add in cooked meat	13
	Thymus sp.	Xosiny (Am)	Leaves	Boil and drink as tea	30
Lauraceae	*Cinnamomum verum* J.Presl	Kerefa (Am)	Bark	Added in tea	20
	Persea americana Mill.	Avokaadoo (AO)	Fruit	Eat fruit	20
Moringaceae	*Moringa stenopetala* (Baker f.) Cufod.	Haleko (Wo)	Leaves	Boil and drink as tea	7

Myrtaceae	*Eucalyptus globulus* Labill	Beharzaf (Am), Akaakltii adii (AO), Baxarsaf (So)	Leaves	Fresh leaves boiled and inhaled	85
	Psidium guajava L.	Roqaa (AO)	Fruit	Eat fruit	7
Musaceae	*Musa* sp.	Muuz (Am), Muuzii (AO)	Fruit	Eat fruit	7
Poaceae	*Hordeum vulgare* L.	Garbuu (AO)	Seeds	The powder is eaten as porridge	13
	Eragrostis tef (Zucc.) Trotter	Xaafii (AO)	Seeds	Bake the bread and eat with butter and 'qocqocaa' made from *C. frutescens*	7
	Eleuisine coracana Gaertn.	Daagujjaa (AO)	Seeds	Added in preparation of local alcohol called 'arakee' and 'tella'	137
	Saccharum officinarum L.	Shankora (AO)	Stem	Hot stem eaten	7
	Zea mays L.	Boqolo (AO, Am)	Seeds	Added in preparation of local alcohol	137
Ranunculaceae	*Nigella sativa* L.	Abasuuda guracha (AO) Xiqur azmud (Am)	Seeds	Dried powder sniffed	300
Rhamnaceae	*Rhamnus prinoides* L'Her.	Gessho (AO, Am)	Leaves	Added in preparation of local alcohol	137
Rosaceae	*Hagenia abyssinica* (Brace) J.F.Gmel.	Heexoo (AO) Koso (Am)	Fruit	Added in local alcohol called 'Arakee'	137
Rubiaceae	*Coffea arabica* L.	Buna (AO)	Seeds	The powder mixed with honey; Drink mixed with butter	59
Rutaceae	*Citrus limon* (L.) Burn.f.	Loomii (Am, AO) Lendenan (So)	Fruit	Squeeze juice and drink or boil the juice with tea	470
	Citrus aurantium L.	Qomxaxe (Am)	Fruit	Squeeze the juice	20
	Citrus sinensis (L.) Osbeck	Birtukana (AO), Birtukan (Am)	Fruit	Drink the juice or eat	150
	Ruta chalepensis L.	Xenadam (Am), Cilaaddaama (AO), Tserti (Sh)	Leaves	Boiled with coffee	137
Solanaceae	*Capsicum annuum* L.	Qaaraa (AO)	Fruit	Eat raw mixed with vegetables or add in cooking 'Ukkaamsa'	196
	Capsicum frutescens L.	Mimmixa (AO), Mixmixxa (Am)	Fruit	Use in cooking	59
	Nicotiana tabacum L.	Tamboo (AO)	Leaves	-	13
	Solanum lycopersicum L.	Timatim (Am), Timaatima (AO)	Fruit	Eaten raw or cooked	7
	Solanum tuberosum L.	Dinich (Am)	Tuber	Make the syrup	13
Zingiberaceae	*Curcuma longa* L.	Erd (Am)	Rhizome	Added in cooking	7
	Zingiber officinale Roscoe	Giginbila (AO), Zingibil (Am)	Rhizome	The rhizome is crushed, mixed with ginger, boiled, and drunk as tea. The tea is locally called 'Qishir' or 'Qishirii'	588

Methods of preparation of traditional medicine and routes of administration

The most common method of preparation of traditional medicine for COVID-19 prevention was crushing (41.2%), followed by boiling (28.6%), and 19.3% of traditional medicinal plants were prepared via chewing (Figure 2). Most medicinal plant preparations involved using single plant species or a single plant part (66%), while those mixing different plants or plant parts (34%) were rarely reported in the survey. Results of analysis of the route of administration of medicinal plants for COVID-19 prevention revealed that the medicinal plants were administered orally (89%), nasal (7.5%), and others (3.5%).

Consumption of medicinal plants and recommendations for covid-19 prevention

The respondents mentioned that they were using medicinal plants for COVID-19 prevention at least once a day, which accounts for (41.3%), followed by twice a day (30.6%), three times a day (21.5%), and four times a day (6.6%). Most of the respondents (52.4%) were also mentioning that they believe the medicinal plants they consumed can prevent the risk of COVID-19 infection. They indicated that the plant species could prevent and cure the COVID-19 disease in various ways. One of the most reported mechanisms was through boosting immunity. Others believed that the plant species used could kill the virus while in the nose and throat. Several respondents also reported that the presence of phytochemicals in the plant species has the potential to stop the virus and avoid multiplication. A remarkable number of respondents (40.3%) also indicated that they are unsure if the medicinal plants they used prevented them from the diseases. Only 7.3% of respondents indicated that medicinal plants do not contribute to preventing the COVID-19 disease.

A total of 595 (87.5) respondents recommended medicinal plants to prevent COVID-19 to other people, whereas 85 (12.5) respondents did not recommend it. A total of 250 (42.1%) of the respondents had moderate recommendations, whereas 108 (18.2%) made a low recommendation (Figure 3).

Medicinal plant growing activities

During COVID-19, 202 respondents (30%) were growing more medicinal plants than before the pandemic, and only a few had just begun (60 respondents; 8.9%) (Table 2).

Information sources of medicinal plants used for COVID-19

People use various sources to prevent COVID-19, including social media sites like Facebook, WhatsApp, Telegram, Twitter, national health authority records, and local communities. The majority of respondents (49.6%) indicated that the information source of medicinal plants is from local communities. A remarkable number of respondents (24.4%) indicated that social media was their main source of information on medicinal plants used for COVID-19 prevention or cure (Figure 4).

Side effects of medicinal plants and antidotes

The majority of respondents (277) indicated medicinal plants used to prevent and treat COVID-19 disease had no side effects. In contrast, 256 (37.6%) indicated they weren't sure whether they did, and 147 (21.6%) reported medicinal plants had side effects if taken in excess. The main problem with medicinal plants is affecting the stomach and causing gastritis. In addition, nausea and vomiting happened to respondents who took a high concentration of medicinal plants. Respondents also recommended that taking a minimum dose is the best solution. When the problem happened, they used to drink plenty of milk and water and eat *Linum usitatissimum* and *Sesamum indicum* as antidotes against side effects.

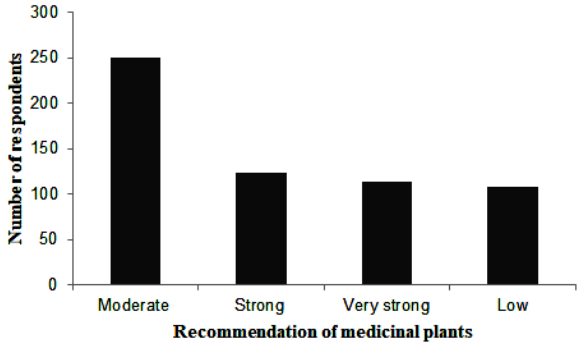

Figure 3. Recommendation on medicinal plants for COVID-19 prevention

Table 2. Medicinal plants growing status during COVID-19 pandemic

Medicinal plants growing status	No. of respondents	Percentage (%)
More than before the pandemic	202	29.8
Same	176	25.8
Never grow	148	21.8
Less than before the pandemic	94	13.7
Started	60	8.9

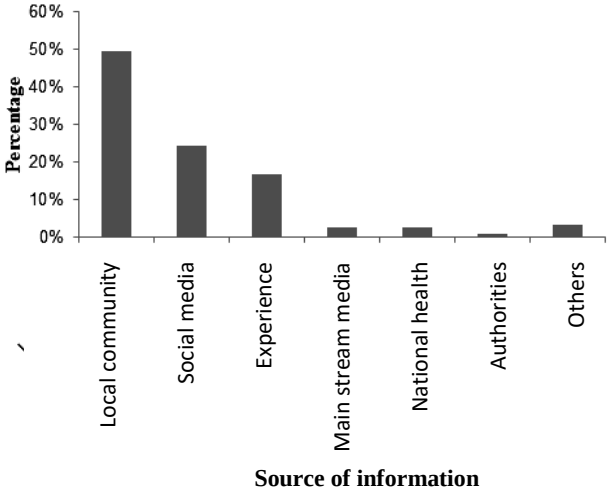

Figure 4. Source on information of medicinal plants used

Price of medicinal plants before and after the COVID-19 pandemic

Promotion of medicinal plants on social media regarding their effectiveness in preventing and curing COVID-19 increased the demand and price of certain plant species. A total of 423 (62%) of respondents indicated that they observed and experienced price increments on medicinal plants considered beneficial during the pandemic. For instance, the price of lemon, garlic, and ginger has gone up at least twofold during the pandemic, mainly in the first three months. A kilo of garlic was sold at 73 birrs (1.8 USD) per kilogram on average, but the price went to 171 birrs (4 USD) during the pandemic. The price of ginger also increased from 40 (1 USD) to 86 birr (2 USD) per kilogram, whereas the price of lemon went from 30 birrs to 68 birrs (1.7 USD) per kilogram in the market during the pandemic.

Preference of people comparing modern medicine or vaccine and traditional medicine

Respondents indicated that they use traditional medicine, modern medicine, or both for preventing or curing COVID-19 disease. An equal number of respondents (40% each) indicated using either modern drug/vaccine or traditional medicine for the disease, whereas 20% of respondents claimed that both traditional and modern medicines would be used if the coronavirus infects them.

Food and beverages used for COVID-19 prevention and treatment

Medicinal plants were not the only solution for prophylaxis and treatment of COVID-19 used by Ethiopian communities. The most important use categories other than medicinal plants were food and beverages. During the lockdown, respondents reported regular consumption of foods linked with perceived beneficial effects. Among the widely consumed foods during the lockdown include raw egg mixed with sugar, honeybee products, honey made from other insects locally called 'Daamuu', fruits, barley porridge, 'Shaameetaa' made from seeds of *Brassica carinata*, 'Ukkaamsaa' or 'Affaany' made from a mixture of various meat mixed with garlic, onion, and hot pepper. Among the beverages used include tea made from garlic and ginger, chamomile tea, tea made from various fruits associated with alcohol, locally called 'Arakee' made from a mixture of various plant species (*Eleusine coracana*, *Hordeum vulgare*, *Rhamnus prinoides*, and *Zea mays*), 'Kosso Arakee' made from *Hagenia abyssinica* and warm water mixed with salt were considered beneficial for preventing and treating the disease (Table 1).

Top ten plant species with relative frequency (RFC)

The relative frequencies of citations ranged from 0.01 to 0.86. The top ten RFC values of species ranged from 0.09 to 0.86. The most cited species was *Zingiber officinale* (588 times cited and frequency of citation was 0.86), followed by *Citrus limon* (470 times cited and frequency of citation was 0.69), and *Allium sativum* was cited 366 times with 0.53 frequency of citation (Table 3).

Table 3. Popular plants with the top frequency of citation

Scientific name	Local name	No. of citation	Frequency
Zingiber officinale Roscoe	Giginbila (AO), Zingibil (Am)	588	0.86
Citrus limon L.	Loomii (AO, Am)	470	0.69
Allium sativum L.	Qullubbii adii (AO), Nech shinkurt (Am)	366	0.53
Nigella sativa L.	Abasuuda gurraacha (AO), Xiqur azmud (Am)	300	0.44
Lepidium sativum L.	Shinfaa (AO), Fexo (Am)	268	0.39
Capsicum annuum L.	Qaaraa (AO)	196	0.28
Citrus sinensis (L.) Osbeck	Birtukana (AO, Am)	150	0.22
Ruta chalepensis L.	Xenadam (Am), Cilaaddaama (AO), Tserti (Sh)	137	0.20
Eucalyptus globulus Labill	Beharzaf (Am), Akaakltii adii (AO)	85	0.12
Brassica nigra L.	Senafich (Am)	65	0.09

Discussions

Diversity of medicinal plants recorded

In the present study, 53 medicinal plant species were claimed to be used to prevent and treat COVID-19. These medicinal plants were distributed across 24 families where Poaceae and Solanaceae were represented by 5 species each. Pieroni et al. (2020) conducted a similar study during the first phase of the pandemic in 17 selected countries, regions, or cities and claimed that 193 plant species from 69 families were used to prevent and cure the disease COVID-19. A study in Morocco recorded 23 medicinal plant species (El Alami et al. 2020), and from the same country by Chaachouay et al. (2021), 20 medicinal plant species were reported. A study conducted in Nepal reported that 60 medicinal plants were used to prevent and cure COVID-19 disease (Khadka et al. 2021). Khabour and Hassanein (2021) from Egypt documented 9 medicinal plants, including the commonly used medicinal plants, i.e., *Ocimum basilicum*, *Trigonella foenum-graecum*, and *Z. officinale* in Ethiopia as prophylaxis and treatment of COVID-19. Seven medicinal plants were recorded from Bangladesh to treat the COVID-19 disease (Azam et al. 2020), and three plants were frequently used in Saudi Arabia (Alyami et al. 2020). A difference in the number of medicinal plants may come from methodology, the extent of the study, and the number of participants. For instance, Azam et al. (2020) recorded their study on three patients. The high number of medicinal plants recorded by Pieroni et al. (2020) is due to the extensive coverage of the study areas, including 17 countries.

Our present study revealed that leaves were the most utilized plant parts for COVID-19 prevention or treatment. Similarly, Khadka et al. (2021) and Chaachouay et al. (2021) also reported leaves were the most used plant parts in Nepal and Morocco for COVID-19 prevention and treatment. The latter authors concluded that the preference for leaves was due to their easy availability, collection, and simplicity in drug preparation. Furthermore, photosynthesis takes place in the leaves, and the preservation of the secondary metabolites is effective for the biological characteristics of the medicinal plant (Chaachouay et al. 2021). Therefore, the utilization of leaves over other plant parts is advantageous as it may not cause a detrimental impact on plant species and contribute to conservation (Megersa et al. 2013). The majority of medicinal plants preparation involves fresh conditions, similar to other studies conducted elsewhere in the world (Chaachouay et al. 2021; Assefa et al. 2021). The dependency on fresh materials is often due to the effectiveness of fresh plant species in therapy, as the ingredients are not lost before practice related to the dried plant forms. The use of fresh products is frequently attributed to the efficacy of fresh plant species in therapy since the ingredients are not lost before use, as is the case for dried plant forms (Chaachouy et al. 2021).

The present study found popular species of plants used during the COVID-19 pandemic in Ethiopia. The most frequently used plant species were *Z. officinale*, *C. limon*, *A. sativum*, and *Nigella sativa*. The popularity of these species was also reported in similar studies conducted in Saudi Arabia (Alyami et al. 2020), Morocco (El Alami et al. 2020), different countries (Pieroni et al. 2020), Nepal (Khadka et al. 2021), and in Egypt (Khabour and Hassanein 2021). Apart from the abovementioned plant species, other popular plant species are mentioned in the North-Western part of Morocco (Chaachouy et al. 2021). The most mentioned plants were *Eucalyptus globulus*, *Azadirachta indica*, and *Ziziphus lotus*. The presence of a wide variety of secondary metabolites such as tannins, terpenoids, alkaloids, flavonoids, and glycosides in plants made them have in vitro antimicrobial properties (Cowan 1999; Dahanukar et al. 2000). The *N. sativa* is one of the most used medicinal plants in preventing and treating COVID-19, reported having nigellone and carbonyl polymer of Thymoguinone that inhibits histamine release (Gali-Muhatasib et al. 2006). A molecular docking study on this plant showed that it decelerates COVID-19 and might give better results than the FDA-approved drugs (Kulyar et al. 2021). Despite claims that some plant species can help prevent and treat COVID-19, clinical trials are currently inadequate, according to standard operating procedures (Akalin et al. 2020). As a result, further clinical research is needed to fully comprehend the safe clinical use of medicinal plants (Akalin et al. 2020).

Source of information and price of medicinal plants

People use different sources of information on medicinal plants claimed to prevent and treat COVID-19. During the pandemic, the interest of people in medicinal plants significantly increased. The majority of respondents indicated that the information source of medicinal plants is from local communities, followed by social media. From our experience, we observed that some of the plants used in the COVID-19 prevention and treatments are those used to treat common colds and flues, as indicated by Pieroni et al. (2020). Social media also played a vital role in promoting the use of medicinal plants such as *Z. officinale* and *A. sativum* as 'immune boosters' (Alyami et al. 2020; Vandebroek et al. 2020), mainly in younger community members (Pieroni et al. 2020). However, not only during a major health crisis but also for mild, contagious, and chronic health problems, the trustworthiness and scientific accuracy of the latest sources of information regarding the transmission of home remedies is a critical aspect to be addressed in the future (Pieroni et al. 2020; Khadka et al. 2021). The later authors advised people to follow information from authentic sources related to the COVID-19.

Because of the rising demand for medicinal plants during the pandemic, the price of certain plants has skyrocketed. For instance, a kilo of garlic was sold at 1.8 USD on average, but the price has gone to 4 USD with a two-fold increment during the pandemic. A similar finding was reported in Cambodia, where the price of ginger went up five-fold during the pandemic (Pieroni et al. 2020).

Food and beverages used during the pandemic

Along with medicinal plants, different types of foods (honey, animal products) and homemade beverages (alcoholic and nonalcoholic) were considered during the COVID-19 pandemic. In the present study, respondents indicated consuming more plants rich in Vitamin C and animal products during the pandemic. Vitamin C was the most commonly used food supplement to increase immunity and reduce the chance of contracting COVID-19 in Saudi Arabia (Alyami et al. 2020) and Egypt (Khabour and Hassanein 2021).

Plant species used as food can help boost the body's immune system and prevent the manifestation of COVID-19 (Yang et al. 2020). Citrus fruits, kiwi fruits, and broccoli are all high in Vitamin C. Vitamin A is abundant in carrots, spinach, and sweet potatoes, among other vegetables. This vitamin comprises a group of fat-soluble compounds that play an important role in immune function and are known to reduce infection susceptibility (Huang et al. 2018). Dietary supplementation of vitamins, bioactive lipids, flavonoids, and herbs may be a tool to support the human immune system against COVID-19 (Galanakis 2020).

Other interventions included honey, homemade alcohol locally called ‘Arakee’, ‘Farsoo’ or ‘Tella’, and ‘Daadhii’ or ‘Tej’. Mixing alcohol with tea, raw eggs and consuming beef full of hot pepper (‘Ukkaaamsaa’) was also a frequently practiced intervention approach during the COVID-19 pandemic. The use of honey, soup made with beef, and alcoholic beverages as prophylaxis and treatment was also reported in other parts of the world (Pieroni et al. 2020; Khabour and Hassanein 2021).

In conclusion, the study assessed foods, medicinal plants, and homemade beverages used among the Ethiopian population during the COVID-19 pandemic. A total of 53 medicinal plants were recorded that claimed to prevent COVID-19 diseases. A considerable proportion of the population also reported using foods and beverages to protect themselves from the disease. Attention toward medicinal plants claimed to boost immunity was increased during the pandemic. Even though information from the local community was a source of medicinal plants knowledge, social media played a remarkable role in promoting the use of medicinal plants for COVID-19 prevention and treatment. Information from social media about homemade remedies should be checked for truth worthiness before being used for the COVID-19 prevention or treatment. Validation of such medicinal plants through extensive investigation of pharmacology and toxicology is recommended to obtain the best out of traditional medicines.

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